

## **Attachment 3 of Package A: Specification**

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## **QUALIFICATION OF CONSTRUCTION CONTRACTOR :**

1. Should have financially sound for executing TK. 1 Crore project.
2. Should have at least 10 years experience in Civil construction projects
3. Should have following manpower (minimum) in his firm :
  - a) A Graduate Civil Engineer with 7 yrs of working experience or a Diploma Civil Engineer with 10yrs working experience. Their practical experience in piling and concrete work is mandatory. Must enclose their CV reflecting experience in the related field.
  - b) Rigger/Piling Foreman - 1
  - c) Mason - 1
  - d) Rod binder - 1
  - e) Formwork Carpenter - 1
  - f) General Foreman - 1
4. Should possess following equipment & tools :
  - a) Piling Rig
  - b) Winch Machine
  - c) Tremie Pipe
  - d) Casing Pipe
  - e) Concrete Mixture Machine
  - f) Welding Machine
  - g) Rod Cutting Machine
  - h) Concrete Vibrator
  - i) Water Pump

- j) Drilling Machine
- k) Grinding Machine
- l) Small Generator 3 KVA
- m) Concrete measuring box
- n) Slump Cone
- o) Cylinder/Cube Mould
- p) Mini truck/Similar Vehicle

5. Should have sufficient number of steel props , formworks & shattering materials .

## **MAJOR ITEMS OF WORK :**

1. Dismantle existing structure
2. Excavation
3. Piling work
4. Concrete work
5. CFRP (Carbon Fiber Reinforced Polymer) of non-reinforced masonry wall

### **TIME SCHEDULE :**

A tentative time schedule is enclosed.

Contractor may submit his own Time schedule.

<b>TECHNICAL SPECIFICATION :</b>
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## **Section - 1A**

### **EARTH WORK**

#### **1. SCOPE OF WORK**

1.1 The work includes but not necessarily limited to, the furnishing all materials and equipment and performing all operation necessary for and properly incidental to accomplishing all excavating, removal of surplus materials away from site, compacting, backfilling and grading work, trenching and backfilling for utilities as necessary to complete the project as shown and noted on the drawings and specified therein.

1.2 Any sub-soil investigations conducted by the Employer/ Consultant representative will be made available for the Contractor's review. USG assumes no responsibility regarding the correctness of these data and makes them available solely for information. It is responsibility of the Contractor to verify all sub-surface conditions prior to submitting the Bid.

#### **2. APPLICABLE STANDARDS**

2.1 Pertinent provisions of the following listed current reference standards shall apply to the work of this section, except as they may be modified herein, and are hereby made a part of this specification to the extent required.

2.1.1 American Society for Testing and Materials (ASTM);

D1556 Test for Density of Soil in Place by Sand-Cone Method.

D1557 Test for Moisture-Density Relations of soils, using 10-pound Rammer and 450mm Drop.

#### **3. SPECIFICATIONS**

3.1.1 Fill: All soil or granular materials placed to raise the natural grade of the site or to backfill excavation.

3.2 On-site Material: Soil or granular material which is obtained from the required excavation on the site bounded by the property limits.

- 3.3 Imported Material: soil or granular material which is hauled in from off-site areas.
- 3.4 Selected Material : On-site and /or imported material which is approved by the EIC's representative for use as mechanical fill.
- 3.5 Compacted Fill: Fill upon which the EIC's representative has made sufficient observations and test to determine and confirm that the fill has been placed and compacted in accordance with the specification requirements.
- 3.6 Degree of Compaction : The ratio, expressed as a percentage, of the dry density of the fill material as compacted in the field to the maximum dry density of the same material as determined by ASTM Test Designation D 1557 above.

#### 4. INSPECTION AND TESTING

- 4.1.1 All site preparation, cutting and shaping, excavating, filling shall be carried out under the inspection and control of the CO and the COR and/or the A & E representative, who will perform appropriate field and laboratory test to evaluate the suitability of fill material, the proper moisture content for compaction and degree of compaction achieved. Any fill that does not meet the specification, requirements shall be removed and/or re-compacted until the requirement are satisfied.
- 4.1.2 Cutting and shaping, excavating, conditioning, filling and compacting procedures require approval of the CO and the COR and/or the A & E representative as they are successively performed. Any work found unsatisfactory or any work disturbed by subsequent operations before approval is granted shall be corrected in an approved manner as directed by the CO and the COR and/or the A & E representative.
- 4.3 Test for compaction will be made for in accordance with test procedure outlined in ASTM D1557(c), as applicable. Field testing of soils or compacted fill in place shall conform with applicable requirements of ASTM D 1556.

#### 5.1 WEATHER CONDITIONS

- 5.2 Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by rain, fill operation shall not be resumed until field test by the Consultant indicates that the moisture content and the density of the fill area as specified in

these specifications or are condition suitable enough, in the opinion of the Employer, for resuming the work.

5.3 The control thought the duration of this Contract shall be sole responsibility of the contractor. Control method shall be subject to the approval of the CO and the COR and/or the A & E representative, including the Contractor's equipment, plans, method and installation procedures etc.

## 6. SOIL MATERIALS

### 6.1 Select material

6.1.1 All material to be used for mechanical fill and backfill shall be an inert, non-expansive soil (less than 50 percent passing a no. 100 standard sieve ), free from vegetable matter and other deleterious substances, and of such quality that it will compact thoroughly without the presence of excessive voids when watered and rolled. Fill material shall not contain rocks or lumps over 4 inch in greatest dimension. All fill materials to be used under the building, slabs, pavements and structures and backfill shall be on-site and/or imported material, conforming to the above, with a liquid limit less than 30 and plasticity index less than 15. Excavated on-site material will be considered suitable for compacted fill if it is free from organic matter and other deleterious substances and conforms to the requirements specified above.

The Consultant shall be notified at least one week prior to start the filling and backfilling operations so that he may select for approval samples of the material intended to be used for filling and backfilling. No material shall be placed without the approval of the CO and the COR and/or the A & E representative.

### 6.2 On-site Material

6.2.1 Excavated earth material which is suitable for compacted fill or backfill, as determined by the CO and the COR and/or the A & E representative, shall be conditioned for reuse and properly stockpiled as directed for later filling and backfilling operations. Conditioned material shall be free of debris and rubble. All rocks and aggregates exceeding 100 mm in largest dimension and deleterious materials shall be removed and disposed off in a manner as specified herein the specifications.



#### 6.3.1 Imported Material

- 6.3.1 Where conditions require the fill material to be imported shall be granular soil totally free of organic matter and shall meet or exceed the minimum requirements specified above have to be selected. In addition , imported material may consist of pit-run sand or sand-gravel mixture with a minimum size of 75 mm and not more than 5 percent passing a no. 200 US standard Sieve (wet sieve).

#### 6.4 Sand

Sand for compacted sand fill under concrete footings, foundations, slabs, and/or brick soling or for aggregate drainage fill, shall be a clean and graded, all passing a no. 4 US Standard Sieve, conforming generally to ASTM C33 for fine aggregate, with fineness modulus not less than 1.2 or as determined by the CO and the COR and/or the A & E representative.

#### 7. STAKES AND GRADES

- 7.1 Contractor shall layout his work, establish all necessary marks, bench marks, grading stakes and other stakes as required, all as specified herein the specifications.
- 7.2 Finished elevation for work to be constructed under this contract are indicated in the drawings and unless an inconsistency therein is brought to the attention of the CO and the COR and/or the A & E representative in writing prior to commencement of construction, the contractor will be held responsible for the proper location and elevation of all work.

#### 8. EXCAVATION

- 8.1 Excavation for foundations, pits, trenches, footings, floor slabs, concrete walks, roadway pavements, parking areas and apron and any other structures indicated as well as common excavation for grading purposes, shall be to the lines and levels required. The bottom of all trenches shall be to grade, tamped firm, clean and free from all debris or foreign matter.
- 8.2 Excavation shall be kept free from water at all times. Adequate equipment shall be maintained at the site in accordance with art. 5 above.
- 8.3 If material below and beyond the required dimensions has been removed or disturbed due to unauthorized over excavation or for any other reason, the space shall be placed, filled and

compacted with select material, as directed by the CO and the COR and/or the A & E representative, with no additional cost to the owner.

- 8.4 Excavated earth material which is suitable for compacted fill or backfill, as determined by the Consultant, shall be conditioned for re-use and properly stockpiled for later use as hereinbefore specified under "Soil Material".
- 8.5 Abandoned sewers, piping and any other utilities encountered in the progress of excavation, shall be removed and the ends plugged with concrete or in any other manner which is acceptable to the CO and the COR and/or the A & E representative.
- 8.6 Active sewers, water and gas pipes, electric power, light or telephone poles, conduits or wires and any other active utility lines encountered, shall be immediately reported to the CO and the COR and/or the A & E representative and the relevant authorities involved. The owner and proper authorities shall allow free access take that measure they may deem necessary to repair, relocate or remove the obstruction as determined by the owner's representative to the satisfaction of the CO and the COR and/or the A & E representative.
- 8.7 All debris and excess earth shall be removed from the site and disposed off as specified in section 1C of this specification.
- 8.8 Open excavations, trenches and the like shall be protected with fences, barricades, cover and railing as required to maintain safe personnel and vehicular traffic passage. Freshly graded surfaces shall be protected from erosion until such time as permanent drainage and erosion control works have been installed.
- 9. COMMON FILL
  - 9.1.1 Where pits, holes, low spots, or depressions are required to be filled or backfilled in order to bring the finish grade to the grades and elevations indicated in the drawings, and where structures are not involved, the fill material shall be suitable on site or imported material which contains no more than 10 percent by volume of organic material. Common fill requires approval of the CO and the COR and/or the A & E representative before it may be used.
  - 9.1.2 Common fill shall be spread uniformly in layers not to exceed 300 mm before compaction. Compaction shall be 85 percent. If required to be moistened or dried, follow the procedures hereinbefore specified for compacted fill

10. BACK FILLING

10.1. Backfilling shall not be placed against footing or building walls or other structure approved by the CO and the COR and/or the A & E representative.

10.2 Backfill material shall consists of select material as herein before specified for compacted fill.

10.3 Backfill shall be placed in 150 mm layers, leveled, rammed and tamped in place.

Jetting shall not be permitted; excessive puddling will not be permitted. Compaction of all layers shall be 95 percent.

11. FINISH GRADING

Finish grading in all areas shall be to elevation and grades indicted on the drawings.

12. METHOD OF MEASUREMENT

12.1 Excavation and backfilling

All excavation shall be measured between the outside lines of the element in plan. No extra measurement shall be allowed for excavation in excess of that shown in drawing. Measurement for backfilling to trenches by using excavated materials shall be measured for payment. The unit of measurement shall be in cubic feet (cft)

12.2 Filling, Common or Compacted

Measurement shall be made for completed work in place and shall be determined by pre-work contour levels multiplied by average sections of fills. Backfilling of foundation trenches and pits, if

not by using imported materials, shall not be measured for payment. The unit of measurement shall be in cubic feet (cft).

## **SECTION – 1B**

### PLAIN AND REINFORCED CONCRETE

#### 1. SCOPE OF WORK

The work to be performed under this section includes the manufacturing, transporting, placing, finishing and curing of all concrete as shown and noted on the drawings and as specified herein.

#### 2. APPLICABLE STANDARD

2.1 Pertinent provisions of the following listed reference standards shall apply to the work of this section, except as they may be modified herein and are hereby made a part of this specification to the extent required.

2.2 American Concrete Institute (ACI) ; Current issues

ACI 301 Specifications for Structural Concrete for Building

ACI 211.1      Recommended Practices for Selecting Proportions of Normal Weight  
Concrete

ACI 304      Recommended Practices for Measuring, Mixing, Transporting and Placing of  
Concrete

ACI 305 Recommended Practices for Hot Weather Concreting

ACI 318 Building Code Requirements for Reinforced Concrete.

2.3. American Society for Testing and Materials (ASTM)

C 31      Making and Coring Concrete Compressive and Flexural Strength Test Specimens in  
the field.

C 33      Specification for Concrete Aggregates.

C 39      Test for Compressive Strength of Cylindrical Concrete Specimens.

C 42	Obtaining and Testing Drilled Cores and Sawed beams of Concrete.
C 87	Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar.
C 136	Test for Sieve or Screen Analysis of Fine and Coarse Aggregates.
C 143	Test for Slump of Portland Cement Concrete.
C 150	Specification for Portland Cement.
C 172	Sampling Fresh Concrete.
C 494	Specification for Chemical Admixtures for Concrete.
D 1751	Specification for Expansion Joint Fillers for Concrete Paving and Structural Construction (No Extruding and Resilient Bituminous Type ).
D 1850	Specification for Concrete Joint Sealer, Cold-Application Type.

### 3. MATERIALS

3.1 Portland Cement : Portland cement shall conform to the specification for Portland Cement (ASTM C-150 or equal, Type-1).

3.1.1 The cement shall be stored in such a manner as to permit easy access for proper inspection and handling. One brand of cement shall be used throughout on the same work except by written permission from the CO and the COR and/or the A & E representative; different type of cement shall be stored separately and shall not be mixed. The cement shall be protected from moisture and damage in transit and in storage. The floor of the store room shall be raised at least 300 mm from ground by wooden platform, dunnage, or pallet and shall be maintained moisture free at all times. Deteriorated and hardened cement will not be permitted in the work and will be rejected by the CO and the COR and/or the A & E representative. Any cement rejected shall be promptly removed from the site.

3.1.2 The cement shall meet the chemical and physical requirements of ASTM C 150 for type 1 cement. A supplier's certificate attesting to the compliance of the cement to the ASTM requirement shall be furnished with each shipment and from each source of cement procured. No cement will be approved for use in the work without such certification. The CO and the COR

and/or the A & E representative may, at his opinion, arrange to sample and test cement delivered, in accordance with ASTM Standard, for verification of quality. Cement failing to pass such tests will be rejected for in the project.

3.2 Concrete Aggregate: Concrete aggregates shall conform to the “Specification for Concrete Aggregates” ASTM C-33 or to a standard acceptable to the CO and the COR and/or the A & E representative producing concrete strengths called for in Section 11.05 of these specifications.

3.2.1 Fine Aggregates

- a) General characteristics: Fine aggregate shall consist of natural sand conforming these specifications.
- b) Grading: Fine aggregate shall be graded within the following limits, using U. S. Standard sieve sizes:-

Sieve	Percentage Passing
20 mm	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	02 to 10

The fine aggregate shall have not more than 45 percent retained between any two consecutive sieves as shown above and its fineness modulus shall not less than 2.5.

c) Deleterious Substances: The amount of deleterious substances in fine aggregate shall not exceed the limits prescribed below :-

Item	Maximum, percentage by Weight of total samples
Clay lumps	3.0
Materials finer than no. 200 sieve	5.0
Coal and Lignite	1.0
Chloride content	Nil

d) Organic Impurities

1. Fine aggregates shall be free of injurious amounts of organic impurities. Except as herein provided, aggregate subjected to test for organic impurities and producing a color darker than the standard shall be rejected.
2. A fine aggregate failing in the test may be used, provided that the discoloration is due principal to the presence of small quantities of coal, lignite or similar discrete particles.
3. A fine aggregate failing in the test may be used, provided that, when tested for the effect of organic impurities on strength of mortar, the relative strength at 7 days calculated in accordance with method ASTM C-87 is not less than 95 percent.
4. Fine aggregate shall not contain any materials that are deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of mortar or concrete.

- e) Soundness : Fine aggregate subjected to five cycles of the soundness test, shall show a loss, weighted in accordance with the grading of sample complying with the limitations set forth under the head “Grading” not greater than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

- 3.2.2 a) Coarse aggregate : Coarse aggregate shall be as per Clause 4.3 and conforming to the requirements ASTM C-33 and shall be clean, hard, tough and grade in size, free from vegetable or other organic matter. The size coarse aggregate shall be one of the three sizes tabulated below but should be as large as possible while conforming to the condition that the largest size of aggregate shall not exceed 1/5 of the narrowest clearance between forms or ¾ of the narrowest distance between parallel reinforcement bars.
- b) Grading: grading requirement of Coarse Aggregate

Sieve No.	Nominal size (Sieve with square opening)	Amounts finer than laboratory sieve (with openings) weight percent.							
		50 mm	40 mm	25 mm	20 mm	12 mm	10 mm	No. 4	No. 8
467	40 mm to No.4	100	95 to 100	-	35 to 70	-	10 to 30	0 to 5	-
57	25 mm to No. 4	-	100	95 to 100	-	25 to 60	-	0 to 10	0 to 5
67	20 mm to No.4	-	-	100	90 to 100	-	20 to 55	0 to 10	0 to 5

The fine and coarse aggregate shall be washed at least once in clean water immediately before being used in concrete production.

- c) Soundness: Coarse aggregate, subjected to five cycles of the soundness test, shall



show a loss, weighted in accordance with the grading of sample complying with designated limitations set forth under “Grading” not greater than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

- d) Limits for deleterious substances in coarse aggregate :-

Item	Percentage by weight of total sample
Clay lumps	0.25
Soft particles	5.0
Materials finer than No.200 sieve	1.0
Coal and Lignite	0.5
Chloride content	Nil

- e) Abrasion : Coarse Aggregates tested for abrasion shall have a loss of not more than 27 percent for stone chips and 33 percent for brick chips. Loss shall be determined on the test size or sizes or more nearly corresponding to the grading is to be used, the limit on abrasion shall apply to each.

- f) The boulders to be used for coarse aggregate shall have the following properties:-

Compressive strength (minimum)	28 Mpa
Specific gravity	2.4 to 2.6
Unit weight	2245 to 2565 kg/ cum.
Porosity	2.1 %
Water absorption	1.5 to 6 % (by wt)
Minimum size	100 mm

### 3.3 Admixture

- 3.3.1 Contractor, shall include in the mix approved concrete admixture, in basement walls and water reservoir to reduce porosity and permeability in concrete and at his option, may also include approved admixture in the mix to improve the water-cement ratio or workability of the concrete, providing the strengths specified and other desirable characteristics of the concrete can be achieved and maintained. Chemical admixtures shall conform to the applicable requirements of ASTM C-494.
- 3.3.2 Applicable products are “patient” Concrete Densifier as manufactured by by Sika Chemical Corporation, Passaic, New Jersey, Pozzoloth as manufactured by Master Builder Co. Cleveland, Ohio. “ Tricosal” as manufactured by the Tricosal Company San Francisco, California or approved equal, of type recommended by the admixture manufacturer for the installation.
- 3.3.3. Any and all admixtures must be approved by the EIC’s & Consultants representative and must be part of the laboratory designated mix before they used in the project.
- 3.3.4 Water: Water used in concrete shall be potable and free from objectionable qualities of silt, acid,alkali, salt, oil or any other impurities.
- 3.3.5 Curing Materials: Where it is required to cure or protect wall surfaces or other vertical surfaces after form removal, furnish appropriate water proof sheet materials conforming to ASTM C171 or burlap conforming generally to Fed. SPEC. CCC-C-467. Where it is required to protect slab surfaces, use appropriate waterproof sheet materials conforming to ASTM C-171.
- 3.3.6 Combination Curing/hardening Compound: All concrete slabs, both interior and exterior, shall be cured, sealed and hardened with a combination chemical clear liquid compound, such as “Hunt Process M d & C” as manufactured by Hunt Process Co. Inc., “Magic Kote Cure and Hard” as manufactured by Symon Corporation, or approved equal.
- 3.3.7 Expansion Joint Filler: Resin bonded cork of size and thickness as shown on the drawing.
- 3.3.8 Expansion Joint Sealing Compound: Cold-applied poured latex rubber tyoe sealant, conforming to ASTM D-1850.

#### 4 LABORATORY TEST OF MATERIALS

4.1 General : Testing of cement and aggregates will be performed in a qualified testing laboratory. The laboratory will perform all tests requested and authorized by the CO and the COR and/or the A & E representative. Tests and manufacturer's certification of compliance with ASTM Specifications will be accepted in lieu of testing of cement, and analysis of aggregates. The CO and the COR and/or the A & E representative may order independent verification tests, at his discretion. Tests and services will consist of the following :

1. Testing of Portland cement in accordance with ASTM C-150.
2. Analysis of aggregates in accordance with ASTM C-33 and sieve analysis of fine and coarse aggregates in accordance with ASTM C-136.

4.2 Samples: Contractor shall furnish and deliver identified sample of all materials required for analysis and tests in the amounts required by the testing laboratory without charge. Deliver samples of cement and aggregates to the Testing Laboratory at least 30 days prior to use on the job.

4.3 Strength of concrete : As Shown in the working Drawing .

5.1 Design of Concrete mixes, including recommended amount of admixture (if any) and water to be used in the mixes, shall be determined by the Contractor by test before actual work.

5.2 Upon receipt of acceptable design mixes from the Testing Laboratory, Contractor shall submit these designs to the client/consultant for review.

5.2.1 Contractor shall be responsible for incorporating into the structure concrete of the minimum strengths and slumps specified on the basis of approved mix design. No casting shall be allowed without the mix-design report.

#### 6. MIXING

- 6.1 Mixing of ingredients shall be conducted in a mixture machine of approved type. Mixing shall be continued after all ingredients are in mixer for at least 1.5 minutes before any part of batch is released. Drum shall revolve at the rate of 15 to 20 revolutions per minute. Drum shall be completely emptied before any portion of succeeding batch is placed therein. Total volume of all materials used per batch shall not exceed catalogue-rated capacity of the machine.

Water tank shall so arranged that the amount of water can be positively measured, while

Tank is discharged, inlet shall be cut off automatically.

## 7. PROPORTIONING

- 7.1 The proportions in which the various ingredients are to be used for different parts of the work shall be as determined by laboratory tests. All cost related to the test shall be borne by the contractor.
- 7.2 All materials shall be measured by volume or by weight, but either method must be approved by the CO and the COR and/or the A & E representative. Cement content shall be the minimum amount necessary for strength, workability and plasticity. Total water for each batch shall be the minimum amount to produce a plastic mixture which will work readily into the corners and angles of the forms and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to accumulate on the surface. The method of measuring consistency of concrete shall be controlled and checked by slump test at site.
- 7.3 The following slumps are suggested for the different concrete members :

		Minimum	Maximum
1.	Foundation, footing, pile cap	25 mm	40 mm
2.	Column, beam, lintel, wall	25 mm	40 mm
3.	Suspended structural slab	25 mm	40 mm
4.	Thin member	40 mm	50 mm
5.	Pile	75 mm	100 mm

The suggested slump of the concrete shall be as shown above. However, CO and the COR and/or the A & E representative reserves the right to order a higher or lower slump to be used whenever, in his opinion, concrete of a particular structure is required to be deposited with higher or lower slump. During the course of work, tests will be made by the contractor under the direction of the CO and the COR and/or the A & E representative and the contractor shall render all the necessary assistance for carrying out these tests. The amount of water to added to the concrete mix shall be determined by means of standard slum tests, (ASTM C-143) which shall be carried out daily while concrete is being placed.

## 8. TESTING OF CONCRETE

8.1 Slump: This determination shall be made at the commencement of concreting, on the occasion of each change in mix proportion, and thereafter as desired by the CO and the COR and/or the A & E. The test shall be in accordance with ASTM C-143.

### 8.2 Strength Tests

8.2.1 The Consultants field personnel will prepare and cure compression test samples. One set of at least three cylinders will made in accordance with ASTM C-31 for each 100 cum of concrete fraction thereof placed each day.

8.2.2 Composite samples will be taken in accordance with ASTM C 172. Each sample will be obtained from the different batch of concrete on random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.

8.2.3 All cylinders in a set will be marked with a number on one end. The Consultant will record this number on record of concrete placed. The cylinders will be cured at job site under field condition.

8.2.4 One cylinder from each set shall be tested at 7 day and a second at 28 days in accordance with ASTM C39 in the laboratory as directed by the CO and the COR and/or the A & E representative. Strength at 7 days shall not be less than 75 % of the design strength.

8.2.5 The third cylinder from each set shall be kept at the job site until the 28-day test report on the second cylinder in the same set has been received by the CO and the COR and/or the A & E

representative. If this report is satisfactory, discard the third the third cylinder. In the event the second cylinder test result are below the required strength, the laboratory will then test the third cylinder at the age selected by the CO and the COR and/or the A & E representative.

- 8.2.6 In the event the compressive strength of the third cylinder, when tested, is below the specified minimum, The CO and the COR and/or the A & E representative may require core test of hardened structure. The core sample shall be tested in accordance with ASTM C42. If such test result indicates below the required strength, the concrete in question shall be removed and replaced without cost to the owner. Any other work damaged as a result of this concrete removal shall be replaced with new materials to the satisfaction of the consultant at no additional cost to the owner. The cost of coring will be deducted from the contract amount. Where core cylinder taken by the laboratory and the concrete proved to be satisfactory, the cut out section shall be restored to the original condition in a manner satisfactory to CO and the COR and/or the A & E representative at no additional cost to the owner.

## 9. CONVEYING AND PLACING CONCRETE

- 9.1 **Notification** : the Consultant shall be notified at least 72 hours in advance of the placing of concrete. In any case, concrete pours shall be performed in accordance with the pre-established schedule.
- 9.2 **Earth Bearing Surface**: Soil bottoms for footings and slabs shall be approved CO and the COR and/or the A & E representative before placing concrete.
- 9.3 **Forms**: Before placing concrete, forms shall be thoroughly inspected. All chips, dirt and debris shall be removed, all temporary bracing and cleats taken out, all opening for pipes, conduits and sleeves, properly boxed, all forms properly secured in their correct position and made tight, all reinforcements, anchors, steel nails, and embedded items secured in their proper places. Concrete which may be on the forms or reinforcements, and which is set or dry, shall be cleaned off and the forms and steel washed off before proceeding. Remove water and all foreign matters from forms and excavations. Unless otherwise directed, sand or sandy loam shall be moist but not saturated just prior to placing concrete.
- 9.4 **Anchors and Embedded Items** : Anchors, bolts, regulates, sleeves, inserts, steel nails, and any other items to be cast or embedded in the concrete shall be accurately secured in position before the concrete is placed.

## **9.5 Handling and depositing :**

- 9.5.1 Concreting, once started, shall be carried on as a continuous operation until the section of approved size and shape is completed.
- 9.5.2 Concrete shall be handled as rapidly as practicable from the mixer to the place of final deposit by methods which prevent the separation or loss of ingredients. It shall be deposited, as nearly as practicable, in its final position to avoid re-handling or flowing.
- 9.5.3 Concrete shall not be dropped freely as it cause segregation. It shall not be dropped freely more than 1200 mm in height. Concrete shall be deposited to maintain a plastic surface approximately horizontal.
- 9.5.4 In placing in wall or thin sections of height greater than 3000 mm, opening in the forms, elephant trunk triemie pipe, or other approved device, shall be used which will permit the concrete to be placed without segregation or accumulation of hardened concrete in the forms or on exposed reinforcement. Such devices shall be installed so that the concrete will be dropped vertically.
- 9.5.5 Concrete which has partially hardened shall not be deposited in the work. The discharge of concrete shall be started less than 60 minutes after the introduction of mixing water. Placing of concrete shall be completed within 60 minutes of the first introduction of water into the mix.
- 9.5.6 Pumping : Concrete may be placed by pumping if first approved in writing by the EIC & Consultants representative for the location proposed. Equipment for pumping shall be such size and design as to insure continuous flow of concrete at the delivery end without separation of materials. The concrete mix shall be designed to the same requirements as herein before specified, and may be richer in lubricating components in order to permit proper pumping.

## **9.6 Vibrating and Compacting**

- 9.6.1 All concrete shall be thoroughly compacted and consolidated by suitable means during the operation of placing and depositing, and shall be thoroughly worked around reinforcement, embedded items and into the corners of forms. Internal vibrations shall be used under

experienced supervision and shall be kept out of contact with reinforcement and wood forms. Vibrators shall not be used in manner that forces mortar between individual form members.

- 9.6.2 Vibrators shall be flexible electric type or approved compressed air type, adequately powered and capable of transmitting to the concrete not less than 7000 impulses per minute. Vibration shall be sufficiently intense to cause the aggregate to flow or settle readily into place without separation of ingredients. A sufficient numbers of vibrators shall be employed so that complete compaction is secured throughout the entire volume of each layer of concrete. At least one vibrator shall be kept standby for emergency use. Vibrator shall be such that the concrete becomes uniformly plastic with their use.
- 9.6.3 Vibration shall be close to the forms but shall not be continued at one spot to the extent that large areas of grout are formed or the heavier aggregates are caused to settle. Care shall be taken not to disturb concrete which has its initial set. Vibrators shall not be lowered deeper than the layer placed.
- 9.6.4 Where situation makes compacting difficult or where the reinforcement is congested, batches of mortar containing the same proportion for cement to sand as used in concrete shall first be deposited in the forms, to a depth of at least 25 mm.
- 9.6.5 The responsibility for providing fully filled out, smooth, clean and properly aligned surfaces free from objectionable pockets and blemishes shall rest entirely with the Contractor.

i) CONSTRUCTION JOINTS

- 10.1 When construction joints are necessary, they shall be made and located as indicated in the drawings. If for any reason the contractor feels a change is necessary, he shall devise a placing plan showing all construction joints and shall submit the EIC & Consultant representative for approval. Joints not indicated in the drawings shall be made and located to impair least the strength of the structure and their locations shall be approved by the CO and the COR and/or the A & E representative.
- 10.2.1 Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned with water and air jet, after concrete has semi-set, to remove all laitance. In addition to foregoing, vertical joint shall be thoroughly wetted, but not saturated, before placing new concrete.



10.3 Approved key shall be used at all joints, unless indicated otherwise. All joints not shown on the drawings shall require the prior approval of the CO and the COR and/or the A & E representative. Forms shall be tightened before placing of concrete is continued.

10.3 Control joints in slabs on grade shall be located to surround or enclose areas not exceed 89 sqm with a maximum one-way dimension of 10 m.

## 11. PROTECTION AND CURING

11.1 Protect concrete from injurious action of the elements defacement of any nature during construction operations.

11.2 Keep concrete in a thoroughly moist condition from the time it is placed until it has cured for at least 14 days but not less than as shown in section 2-A.

11.3 All formwork, until removed, shall be kept continuously wet to prevent drying of the concrete. If any form are removed before the end of ten days after placing of concrete, the exposed concrete shall be kept continuously wet for the remaining period the concrete with burlap kept continuously moist .Concrete shall not be allowed to dry during the curing period because of finishing operations.

11.4 Carefully protect exposed concrete corners from traffic or use which will damage them in any way.

11.5 Protect freshly placed and finished concrete slabs from damage from drying wind or rain by covering with appropriate water proof sheet materials, as and when required.

## 12. CONCRETE FINISHING

Surface finish of concrete shall be according to type of finish in Architectural, structural drawings or in schedule of work.

12.1 "As cast fair face" concrete surface shall receive no extra finishes and shall be level, smooth and free from surface imperfections such as honeycomb, dents, bulges, sand streak, pits, air

bubbles, misalignment, offset and must be uniform in texture and colour all through, as it is cast and shall be acceptable to the CO and the COR and/or the A & E representative. Design of form, proportioning of concrete mix and casting procedure for producing the "As cast fair face" concrete surface shall be the responsibility of the Contractor.

- 12.2 Making up of pits and air bubble etc. may be allowed to some extent only with permission of the EIC & Consultant representative and retouching of surfaces may also be allowed in case of no uniformity of color at contractor's own cost.
- 12.3 Plaster finish concrete surface shall receive plaster finish later and shall be even, level and free from honeycombs, dents, bulges, sand streaks and other defects such as misalignment and offset. Patching of defective works (within limits) shall be allowed only on permission from the CO and the COR and/or the A & E representative.
- 12.4 Sample panels large enough in two lifts of "As cast fair face" concrete shall be built and shall be approved by the CO and the COR and/or the A & E representative at least 30 days in advance before the actual work.

### 13. METHOD OF MEASUREMENT

Measurement shall be made volumetrically by neat outside lines of structural elements as shown in drawing or as directed in writing by CO and the COR and/or the A & E representative for all classes of concrete and shall exclude all works of formwork as specified under section 2-A. Reinforcement and other embedded items shall not be measured for payment under this section. The unit of measurement shall be cubic feet ( cft).

## SECTION – 1C

### REINFORCING STEEL

#### 1. SCOPE OF WORKS

The work to be performed under the provision of this section includes furnishing, cutting, bending and placing of all steel reinforcements for all reinforced cement concrete work as shown on the drawing and as specified herein.

#### 2. CODE AND STANDARDS

2.2 Pertinent provisions of the following listed codes and standards shall apply to the work of this section, as they may be modified herein and hereby made a part of its specification to the extent required.

##### 2.2.1 American Concrete Institute (ACI); Current issue:

ACI 301 specifications for structural Concrete for Building, Chapter 5 –  
Reinforcement

ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.

ACI 318 Building Code Requirements for Reinforced Concrete.

##### 2.2.2 American Society for Testing and Materials (ASTM)

A 82 Specification for Cold-Drawn Steel wire for Concrete Reinforcement.

A 615 Specification deformed and plain Billet-Steel Bar for Concrete  
Reinforcement.

##### 2.2.3 American Welding Society (AWS)

D 12.1 Recommended Practice for Welding the Reinforcing Steel, Metal Inserts  
and Connections in Reinforced Concrete Construction.

#### 2.2.4 Concrete Reinforcing Steel Institute (CRSI)

- a. CRSI Handbook.
- b. Manual of Standard Practice.
- c. CRSI Publication "Reinforcing bar Splices"
- d. CRSI Publication "Placing Reinforcing Bars"

### 3. MATERIALS

- 3.1 Reinforcing Bars: Reinforcing bars(rebar) shall be new, deformed, billet-steel bars, conforming to ASTM A615, with a minimum specified strength of 60 ksi, 70 ksi and ultimate tensile strength of 80 ksi, 95 ksi respectively which will be being bent at room temperature around a pin of the same diameter as of the steel being tested without cracking on the outside of the bent portion.
- 3.2 Welded Wire Fabric : Welded Wire Fabric shall be new, rectangular mesh, welded deformed steel fabric, conforming to ASTM A497. Gauge or diameter of wire and centre to centre spacing of wire shall be as indicated on the drawings.
- 3.3 Accessories: Reinforcing accessories, consisting of spacers, chairs, ties, pre cast concrete blocks and similar item shall be provided as required for spacing, assembling and supporting the reinforcement in place.
  - 3.3.1 For footings, slabs and beams, use supports of concrete blocks and metal chairs. Concrete blocks shall be pre-cast with required thickness and sufficiently cured at least 14 days. Proportion shall not be less than 1:2:
  - 3.3.2 For exposed-to-view concrete surface, where legs of supports are in contact with the forms, provide supports with legs which are hot-dip galvanized or plastic protected or stainless steel protected.
- 3.4 Tie Wire : Tie wire for reinforcement shall be No.22 gauge or heavier, black or galvanized, mild or commercial grade soft steel wire.

#### 4. SHOP DRAWINGS

- 4.1 Fully detailed shop drawings, including bending schedules and bending diagrams, shall be submitted by the contractor to the CO and the COR and/or the A & E representative for review and approval. Shop drawing shall show fabrication and placing details and size & location of all reinforcing steel. Shop drawing shall be prepared in accordance with applicable requirements and guidelines of ACI 315.
- 4.2 Shop drawing shall be such detail and completeness that all fabrications and placements at the site can be accomplished without the use of contract drawings for reference. Shop drawing shall include number of pieces, sizes and markings of reinforcing steel, laps and splices, supporting devices and accessories and any other information required for fabrication and placement.
- 4.3 Contract drawing for air conditioning, anchor bolts schedules and locations, anchors, hangers, inserts, sleeves, conduits, steel rail and other steel sections and any other items to be cast in concrete shall be checked for possible interference with reinforcing steel. Required clearance shall be indicated on shop drawings

#### 5 CERTIFICATION

Mill affidavits or test reports from BUET or similar certification, stating the grades  
and physical properties of the reinforcing steel and conformance with ASTM

Specifications, shall be submitted to CO and the COR and/or the A & E representative before delivery of steel to the job site.

#### 6. DELIVERY, STORAGE AND HANDLING

- 6.1 Steel reinforcement shall be delivered to the jobsite, stored and covered in a manner which will ensure that no damage shall occur to from moisture, dirt, grease or any other cause which might impair bond with concrete.
- 6.2 A sufficient supply of approved reinforcing steel shall be stored at site at all times to ensure that there will be no delay of work.
- 6.3 Identification of steel shall be maintained after bundles are opened.

## 7. IDENTIFICATION

Reinforcing steel shall be bundled and tagged with grade, size and suitable identification marks for checking, sorting and placing. Sizes and mark numbers shall correspond to placing drawings and schedules. Tags and markings shall be waterproof and shall not be removed until steel is placed.

## 8. FABRICATION

- 8.1 General : Fabrication of steel will be in accordance with the shop drawing approved by the Consultant. Where specific details are not indicated, comply with applicable requirements of the code and standard hereinbefore specified.
- 8.2 Cutting and bending : Cutting and bending shall be performed at central location, equipped and suitable for the purpose. Bars shall be accurately cut and bent as indicated on the approved shop drawings. Bars shall be bent cold. Heating of bars for bending or straightening will not be permitted. Bars shall not be bent or straightened in any manner which will injure the material.
- 8.3 Welding : Welding of reinforcement, where indicated or approved, including preparation of bars, shall conform with the applicable requirements of AWS D12.1. welder shall be prequalified in accordance with AWS requirements. Useful penetration butt welds by the electric arc method unless otherwise indicated or approved. Weld splices to develop 125 % of the specified yield strength of the bars, or the smaller bar in transition splices. Clean bar from oil, grease, dirt and other foreign substances and flame dry before welding. Preheat bars before welding. Stagger splices in adjacent bars.
- 8.4 Fabrication tolerances : Where fabrication tolerance are not indicated on the drawing, comply with the applicable requirements specified in ACI 301.

## 9. TESTING

- 9.1 Test of reinforcing steel shall be performed by BRTC, BUET, in accordance with

applicable ASTM Standards and as directed by CO and the COR and/or the A & E representative. The Contractor will arrange for all testing and will pay for all works required of the Testing Laboratory.

- 9.2 When independent laboratory testing is required by CO and the COR and/or the A & E representative, materials to be analyzed or tested shall be delivered to the testing laboratory by the contractor. Specimen for testing shall be taken random from bundles as delivered from the mill.
- 9.3 Further testing of material already delivered to jobsite may be waived by the CO and the COR and/or the A & E representative, provided proper certification has been furnished as hereinafter specified.
- 9.4 All relevant mill and laboratory test results for the materials supplied shall be submitted to the owner & Consultant.
- 9.5 Standard chart for steel is given below:

Measurement of M.S. works shall be given for the linear measurement of reinforcement and weight shall be calculated to the following British Standard BS 4449, BS 4461.

Specification of weight of 1000 kg = 1 Ton

Dia. of Bar mm	Weight Kg / m
6 mm	0.222
8 mm	0.395
10 mm	0.616
12 mm	0.888
14 mm	1.208
16 mm	1.579
18 mm	2.000

20 mm	2.466
22 mm	2.983
25 mm	3.854
28 mm	4.829
30 mm	5.549
32 mm	6.313

No extra claim on account of over weight of rod used than the above standard will be entertained. The contractor shall take into consideration any such differences in weight of rod in the unit price while tendering. Payment for M.S. work shall be made as per approved bar bending schedule for steel reinforcement work.

## 10. PLACING

- 10.1 General : Reinforcing steel shall be placed in accordance with the drawings and approved shop drawings and the applicable requirements of the code and standard herein before specified. Install reinforcement accurately and secure against movement particularly under the weight of workmen and placement of the concrete.
- 10.2 Reinforcement support : Bars shall be supported on metal chairs or spacers or concrete blocks, fully cured min 25mmx25mm accurately placed and securely fastened to steel reinforcement in place at a spacing not more than 1 block per 1 sqm for slab and 1 block /m for beam or as directed by the CO and the COR and/or the A & E representative. Additional bars shall be furnished whether specifically shown on drawings or not where necessary to securely fasten reinforcement in place. Support legs of accessories in forms without embedding in the form surface. Hooks and stirrups shall be accurately spaced and wire to the reinforcing. No wood will be permitted inside the form.
- 10.3 Placing and Tying : reinforcement shall be set in place and rigidly & securely tied or wired with steel tie wire at all splices and all crossing points and intersections in the positions shown. Rebending on bars on jobsite to fit existing conditions will not be permitted without written



authorization of the CO and the COR and/or the A & E representative. Point end of the wire shall be away from the form.

- 10.4 Spacing : Centre-to-centre distance between parallel bars shall be in accordance with the drawings or where not indicated, the clear spacing shall be nominal bar dia but in no case less than 25 mm nor less than 1.33 times the maximum size of aggregate or as directed and approved by the CO and the COR and/or the A & E representative.
- 10.5 Splices : Laps on slices shall be adequate to transfer stress of bond. Unless indicated otherwise on the drawing, lap bars a minimum of 40 times bar dia with hook. Whenever possible, splices of adjacent bars shall be staggered a minimum lap length.
- 10.6 Welded wire fabric : Wire fabric shall be in as long length as practicable and shall be wired at all laps and splices. End laps shall be offset in adjacent widths. Lap shall be a minimum of one full mesh plus 50 mm, welded wire fabric shall be secured in position with suitable supports, accessories and tie wire as indicated and required to ensure against movement from workmen and placement of concrete.
- 10.7 Dowels : Provide dowels where indicated or required. Dowels shall be tied securely in place before concrete is deposited. Provide additional bars for support and anchorage where required. Where sleeves are required for dowels for load transfer in slabs or for other dowels, sleeves shall be black or galvanized steel pipe, standard weight, of size required to clear dowel 3 mm all around.
- 10.8 Protective concrete clear covering : Except where indicated otherwise shown on drawings, the minimum concrete cover for steel reinforcement shall be as follows :-

- |    |  |       |
|----|--|-------|
| 1. | Where concrete is placed against earth trench form | 75 mm |
| 2. | Slabs on grade or against earth                    | 50 mm |
| 3. | Walls below grade, columns                         | 38 mm |

- |    |   |       |
|----|---|-------|
| 3. | Walls above grade & slabs                       | 25 mm |
| 5. | All other formed concrete exposed to earth      | 50 mm |
| 6. | Concrete in Saline zone add 10mm extra covering |       |

Over above mentioned figure.

- 10.9 Placement tolerances: Where placement tolerances are not indicated on the drawing, comply with the applicable requirements specified in ACI 301. Bars may be moved as necessary to avoid interference with other bars, conduit or embedded items. If bars are moved more than one bar diameter, or enough to exceed specified tolerance, resulting arrangement of bars shall be subject to the EIC & Consultant representative's acceptance.

ii) CLEANING.

Reinforcement, when in place, shall be free dirt, loose scale, paint, oil or other foreign materials.

## 11. NOTIFICATION AND INSPECTION

Contractor shall notify the CO and the COR and/or the A & E representative at least 72 hours ahead of each concrete pour, and no concrete shall be placed until all installed reinforcing steel has been inspected and approved by CO and the COR and/or the A & E representative.

## 12. CORRECTION DURING CONCRETE PLACEMENT

Capable steel work men shall be kept on the work at all times during the placing of concrete, and they shall properly reset any reinforcement displaced by runways, workmen, or other causes. Reinforcement shall not be bent after being partially embedded in hardened concrete.

### 13. DEFECTIVE WORK

The following reinforcing steel work will be considered defective and may be ordered by the CO and the COR and/or the A & E representative to be removed and replaced by the Contractor at no additional cost of Owner.

1. Bras with kinks or bends not indicated on drawing,
2. Bras injured due to bending or straightening; and
3. Reinforcement not placed in accordance with the drawing and /or specification.

### 14. METHOD OF MEASUREMENT

Measurement shall be made and paid for actual quantity reinforcement placed in position and embedded in concrete as shown in drawing in as ordered by the

CO and the COR and/or the A & E representative in writing. Measurement shall not include for the splices, laps, spacers, hangers, hooks, welding, wastage of reinforcement, fasteners etc. Standard weight of reinforcement as per ASTM A615 shall be considered in the measurement. The unit of measurement shall be in Kilogram (kg.)

## SECTION-1D

### BRICK FALT SOLING

#### 1. SCOPE OF WORK

The work covered by this item shall consist of supplying and laying brick on

top of the earth sand bed or any where as shown in the drawing to form a sub-base.

## 2. DESCRIPTION OF WORKS

Bricks shall comply with requirements of first class brick unless otherwise specified by CO and the COR and/or the A & E representative. The blinding sand will have F.M:1.5 and shall be lean, free from organic matters. Brick shall be laid flat in surface to contact with adjoining bricks and their joints shall be filled with sand. The sand shall be brushed in until joints are filled. Flushing of sand of sand with water will not be done unless permitted.

## 3. METHODS OF MEASUREMENT

Brick soling shall be measured by the square meter in place. The amount of completed and accepted work, measured as described above, will be paid for at the contract unit price per square feet (sft), which is inclusive of all material, transportation, Placing, labor, equipment, tools and incidental necessary to complete the work.

## Annex – 1:

### Specification/Details of Carbon Fibre Reinforced Polymer (CFRP)

- 1. Introduction :** Carbon Fibre Reinforced Polymer (CFRP) is a epoxy based flexible material. It is extensively used for repair, rehabilitation and strengthening the structural member. It provides high tensile strength.

CFRP is available in the market under trade name Sika, Carbodur, MBrace etc.

- 2. Material:** CFRP of MBrace laminate has 3 grades of following properties and characteristics :

Grade	165/2500	170/3100	210/3300
Mean Tensile Strength in Mpa	2500	3100	3300
Mean Tensile Modulus E (GPa)	165	170	210
Ultimate Elongation (at break)	1.3%	1.6%	1.4%
Fibre content in %	70 %	70 %	70 %
Density g/m <sup>3</sup>	1.6	1.6	1.6
Inter-laminar Shear Strength	80 Mpa	80 Mpa	80 Mpa
Thermal Expansion m/m/°C	$0.6 \times 10^{-6}$	$0.6 \times 10^{-6}$	$0.6 \times 10^{-6}$
Laminate width (mm)	50, 80, 100.		
Laminated thickness (mm)	1.2 or 1.4		

- 3. Application :** Application of CFRP Laminate needs very careful surface preparation. The surface should be sanded down, clean and dry. Oil, grease, dust or any other material from the surface should be removed thoroughly. To ensure maximum adhesion, apply one coat of Mbrace primer and one layer of laminate adhesive by roller or brush. Fix CFRP on it by hard roller by exerting a constant pressure to & fro in the direction of fibre. Clean up area. Then apply adhesive over laminate to create mechanical key for new plaster.
- 4. Safety Precaution :** Consult the material safety data sheet before application. Epoxy resin can cause skin irritation after prolonged or repeated contact. They can also be eye irritant and even cause burns. Use of standard precautions such as safety goggles and chemical resistant gloves is recommended. Cover hands with barrier cream before starting work.

5. **Method of Measurement:** CFRP work shall be measured in square feet unit covering the area where it is fixed. It will be paid as per contract unit price inclusive of all costs of materials, transportation, tools, equipments and other incidentals required to complete the work.